

CLAIMS:

1. A communications system including:

a plurality of base station transceivers linked by some means over which the base station  
5 transceivers communicate;

a plurality of mobile transceivers adapted to communicate via the base station  
transceivers using macrodiversity; wherein

the mobile transceivers are further adapted to control allocation of system  
resources to enable communication.

2. A communications system as claimed in claim 1 wherein the macrodiversity  
includes macrodiversity at a base station transceiver when receiving a signal from a  
mobile transceiver.

3. A communications system as claimed in claim 1 or claim 2 wherein the  
macrodiversity includes macrodiversity at a mobile transceiver when receiving a signal  
from a base station transceiver.

4. A communications system as claimed in any one of claims 1 to 3 wherein the  
channel resources allocation controlled by the mobile transceiver includes the use of  
base station transceiver channels in a communications downlink between a base station  
transceiver and a mobile transceiver.

5. A communications system as claimed in any one of claims 1 to 4 wherein the  
channel resources allocation controlled by the mobile transceiver includes the use of  
base station transceivers in a communications downlink between base transceivers and a  
mobile transceiver.

6. A communications system as claimed in any one of claims 1 to 5 wherein the  
channel resources allocation controlled by the mobile transceiver includes the use of  
base station transceiver channels in a communications uplink between a base station  
transceiver and a mobile transceiver.

7. A communications system as claimed in any one of claims 1 to 6 wherein the channel resources allocation controlled by the mobile transceiver includes the use of base station transceivers in a communications uplink between base transceivers and a mobile transceiver.

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8. A communications system as claimed in any one of claims 1 to 7 wherein the base station transceivers communicate with each other using a wide area network.

9. A communications system as claimed in claim 8 wherein the base stations  
10 transceivers communicate with each other using a wireless wide area network.

10. A communications system as claimed in any one of claims 1 to 7 wherein the base station transceivers communicate with each other using a local area network.

11. A communications system as claimed in claim 10 wherein the base station  
15 transceivers communicate with each other using a wireless local area network.

12. A communications system as claimed in any one of claims 1 to 11 wherein the base station transceiver network is shared with other services.

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13. A communications system as claimed in any one of claims 1 to 12 wherein the base station transceiver network includes a link to another base station transceiver network.

14. A communication system as claimed in claim 13 wherein the link between base  
25 station transceiver networks is a PSTN.

15. A communication system as claimed in claim 13 wherein the link between base station transceiver networks is an internal network.

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16. A communication system as claimed in claim 2 wherein the mobile transceiver is adapted to use macrodiversity by sending a packet to a plurality of base station transceivers.

5 17. A communications system as claimed in claim 16 wherein a base station transceiver or other network node is adapted to use macrodiversity when receiving a signal from a mobile transceiver by receiving packets from a plurality of base station transceivers that have received packets from the mobile transceiver, and combining the received packets using diversity combining.

10 18. A communication system as claimed in claim 17 wherein the base station or other network node is further adapted to use macrodiversity when receiving a signal from a mobile transceiver by forwarding the combined packet to at least one specified base station transceiver for transmission to another mobile transceiver.

15 19. A communication system as claimed in claim 3 wherein the base station transceivers are adapted to use macrodiversity by sending a packet from a plurality of base station transceivers to a mobile transceiver.

20 20. A communications system as claimed in claim 19 wherein a mobile transceiver is adapted to use macrodiversity when receiving a signal from a base station transceiver by receiving packets from a plurality of base station transceivers and diversity combining the packets.

25 21. A communication system as claimed in any one of claims 19 to 20 wherein the base station transceivers use different channels to transmit the packet.

22. A communications system as claimed in any one of claims 1 to 21 wherein the base station transceivers communicate with mobile transceivers using TDMA.

30 23. A communications system as claimed in any one of claims 1 to 21 wherein the base station transceivers communicate with mobile transceivers using CDMA.

24. A communications system as claimed in any one of claims 1 to 21 wherein the base station transceivers communication with mobile transceivers using FDMA.

25. A communication system as claimed in any one of claims 1 to 24 wherein mobile transceivers are adapted to allocate system resources by:

identifying uplink channel usage in the range of the mobile terminal,

identifying one or more spare uplink channels, and

transmitting over the one or identified channels without negotiation with the base station.

26. A communication system as claimed in claim 25 wherein the mobile transceivers are further adapted to allocate system resources by identifying a spare uplink channel for transmission to minimise interference.

27. A communication system as claimed in any one of claims 1 to 24 wherein mobile transceivers are adapted to allocate system resources by:

identifying downlink channel usage in the range of the mobile terminal,

identifying one or more spare downlink channels, and

instructing a transmitting mobile terminal to utilise the identified channel(s) for transmission.

28. A communication system as claimed in claim 27 wherein the mobile transceivers are further adapted to allocate system resources by identifying a spare downlink channel for transmission to minimise interference.

29. A communication system as claimed in any one of claims 25 to 28 wherein a transmitting mobile transceiver is adapted to negotiate the number of links with a receiving mobile transceiver.

30. A communication system as claimed in any one of claims 25 to 29 wherein the mobile transceivers are adapted to split the data to be transmitted into multiple streams and transmit each stream over a separate link.

31. A communication system as claimed in claim 30 wherein a mobile transceiver receiving data transmitted over multiple streams is adapted to combine the multiple data streams.

5 32. A communication system as claimed in any one of claims 25 to 29 wherein the mobile transceivers are adapted to stop using a link if the amount of available channel resources reduces.

33. A communication system as claimed in any one of claims 1 to 24 wherein the  
10 mobile transceivers are adapted to transmit a data stream from a first mobile terminal to a second mobile terminal over a communication system by:

identifying one or more spare channels for the downlink to the second terminal,  
separating the data stream into multiple portions according to the number of  
identified spare channels, and

15 transmitting the multiple portions over the spare channels to the second terminal.

34. A communication system as claimed in claim 22 wherein at each new time slot in the TDMA transmissions the transmit or carrier frequency may change.

20 35. A communication system as claimed in any one of claims 1 to 34 wherein communication between mobile transceivers uses data packets each including a synchronisation sequence and a payload sequence.

36. A communication system as claimed in claim 35 wherein before transmitting  
25 data a mobile transceiver is adapted to provide a distinction between payload sequences and synchronisation sequences in the signal to be transmitted by scanning the payload sequence to determine any portions of the sequence that could be detected as a synchronisation sequence, introducing errors into the portions of the payload sequence, and wherein the introduced errors are within an error correction capability of a payload  
30 error correction code.

37. A communications system as claimed in any one of claims 1 to 36 further including at least one register that can communicate over the communication system and adapted to store at least a portion of the base station transceiver and time slot allocations of the mobile transceivers.

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38. A communication system as claimed in claim 37 wherein the registers are implemented in terminals similar to the mobile transceivers.

39. A communication system as claimed in claim 37 wherein the registers are  
10 implemented in mobile transceivers.

40. A communication system as claimed in any one of claims 37 to 39 wherein each register stores all the base station transceiver and time slot allocations of each mobile transceiver.

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41. A communication system as claimed in any one of claims 37 to 39 wherein each registers stores a portion of the base station transceiver and time slot allocations of the mobile transceivers.

20 42. A communication system as claimed in any one of claims 37 to 39 wherein the base station transceiver and time slot allocations of each mobile transceiver are stored in more than one register.

43. A communication system as claimed in any one of claims 37 to 39 wherein each  
25 mobile transceiver stores the locations of at least one register.

44. A communication system as claimed in any one of claim 37 to 39 wherein when the location of a register changes the new location information is broadcast to all mobile transceivers.

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45. A communication system as claimed in any one of claims 37 to 44 wherein a mobile transceiver uses a register to find the primary and secondary destination base station transceivers or a destination mobile transceiver.

5 46. A communication system as claimed in claim 45 wherein if a register queried by a first mobile transceiver about destination base station transceivers of a second mobile transceiver does not have this information the register forwards the request to another register.

10 47. A communication system as claimed in any one of claims 1 to 46 wherein the mobile transceivers provide a self-organising cell structure.

48. A communication system as described in any one of claims 1 to 47 wherein the system adapts to the addition and/or removal of base station transceivers without the  
15 need to reconfigure the system.

49. A communication system as claimed in any one of claims 1 to 48 wherein the mobile transceivers use signal quality metrics to determine a link over which to transmit.

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50. A base station transceiver adapted to form part of the communications system described in any one of claims 1 to 49.

51. A mobile transceiver adapted to form part of the communications system  
25 described in any one of claims 1 to 49.

52. A method of communicating over communication system including a plurality of mobile transceivers and a plurality of base station transceivers where the base station transceivers are linked together by some means including the steps of:

30 transmitting a signal in the form of packets from a transmitting mobile transceiver, each packet including information identifying a receiving mobile transceiver and at least one destination base station transceiver,

receiving the packet(s) at at least one receiving base station transceiver,  
forwarding the packet(s) to the at least one destination base station transceiver,  
the destination base station transceiver transmitting the packet(s) to the receiving  
mobile transceiver, and wherein

5       at least one of the receiving base station transceiver and the receiving mobile  
transceiver uses macrodiversity, and wherein  
the mobile transceivers control allocation of system resources.

53.     A method of communicating over a communication system as claimed in claim  
10 52 wherein the channel resources allocation controlled by the mobile transceiver  
includes the use of base station transceiver channels in a communications downlink  
between a base station transceiver and a mobile transceiver.

54.     A method of communicating over a communication system as claimed in claim  
15 52 or claim 53 wherein the channel resources allocation controlled by the mobile  
transceiver includes the use of base station transceivers in a communications downlink  
between base transceivers and a mobile transceiver.

55.     A method of communicating over a communication system as claimed in claim  
20 53 further including the step of the mobile transceiver using macrodiversity by sending  
a packet to a plurality of base station transceivers.

56.     A method of communicating over a communication system as claimed in claim  
25 55 wherein a base station transceiver or other network node uses macrodiversity when  
receiving a signal from a mobile transceiver including the steps of receiving packets  
from a plurality of base station transceivers that have received packets from the mobile  
transceiver, and combining the received packets using diversity combining.

57.     A method of communicating over a communication system as claimed in claim  
30 56 wherein the base station or other new work node uses macrodiversity when receiving  
a signal from a mobile transceiver including the step of forwarding the combined packet



to at least one specified base station transceiver for transmission to another mobile transceiver.

58. A method of communicating over a communication system as claimed in claim  
5 54 wherein the base station transceivers use macrodiversity including the step of sending a packet from a plurality of base station transceivers to a mobile transceiver.

59. A method of communicating over a communication system as claimed in claim  
58 wherein a mobile transceiver uses macrodiversity when receiving a signal from a  
10 base station transceiver including the step of receiving packets from a plurality of base station transceivers and diversity combining the packets.

60. A method of communicating over a communication system as claimed in any  
one of claims 58 to 59 wherein the base station transceivers use different channels to  
15 transmit the packet.

61. A method of communicating over a communication system as claimed in any  
one of claims 52 to 60 wherein the method used by mobile transceivers to allocate  
system resources includes:  
20 identifying uplink channel usage in the range of the mobile terminal,  
identifying one or more spare uplink channels, and  
transmitting over the one or identified channels without negotiation with the  
base station.

25 62. A method of communicating over a communication system as claimed in claim  
61 wherein the method used by mobile transceivers to allocate system resources  
includes identifying a spare uplink channel for transmission to minimise interference.

63. A method of communicating over a communication system as claimed in any  
30 one of claims 52 to 60 wherein the method used by mobile transceivers to allocate  
system resources includes:  
identifying downlink channel usage in the range of the mobile terminal,

identifying one or more spare downlink channels, and  
instructing a transmitting mobile terminal to utilise the identified channel(s) for  
transmission.

5 64. A method of communicating over a communication system as claimed in claim  
63 wherein the method used by the mobile transceivers to allocate system resources  
includes identifying a spare downlink channel for transmission to minimise interference.

10 65. A method of communicating over a communication system as claimed in any  
one of claims 61 to 64 wherein the method used by mobile transceivers to allocate  
system resources includes negotiating the number of links with a receiving mobile  
transceiver.

15 66. A method of communicating over a communication system as claimed in any  
one of claims 61 to 65 wherein the method used by mobile transceivers to allocate  
system resources includes splitting data to be transmitted into multiple streams and  
transmit each stream over a separate link.

20 67. A method of communicating over a communication system as claimed in any  
one of claims 61 to 65 wherein the method used by mobile transceivers to allocate  
system resources includes stopping using a link if the amount of available channel  
resources reduces.

25 68. A method of communicating over a communication system as claimed in any  
one of claims 52 to 67 wherein the method used by mobile transceivers to transmit a  
data stream from a first mobile terminal to a second mobile terminal over a  
communication system includes:

30 identifying one or more spare channels for the downlink to the second terminal,  
separating the data stream into multiple portions according to the number of  
identified spare channels, and  
transmitting the multiple portions over the spare channels to the second terminal.

69. A method of communicating over a communication system as claimed in any one of claims 52 to 68 wherein communication between mobile transceivers uses data packets each including a synchronisation sequence and a payload sequence.

5 70. A method of communicating over a communication system as claimed in claim 69 wherein the method communicating includes providing a distinction between payload sequences and synchronisation sequences in the signal to be transmitted by a mobile transceiver by scanning the payload sequence to determine any portions of the sequence that could be detected as a synchronisation sequence, introducing errors into  
10 the portions of the payload sequence, wherein the introduced errors are within an error correction capability of a payload error correction code.

71. A method of communicating over a communication system as claimed in any one of claims 52 to 70 further including at least one register arranged communicate over  
15 the communication system and adapted to store at least a portion of the base station transceiver and time slot allocations of the mobile transceivers.

72. A method of communicating over a communication system as claimed in claim 71 wherein the method of allocating system resources includes the step of a mobile  
20 transceiver requesting information of available base station transceivers slots and channels.

73. A method of communicating over a communication system as claimed in any one of claims 52 to 72 wherein a mobile transceiver uses a register to find the primary  
25 and secondary destination base station transceivers or a destination mobile transceiver.

74. A method of communicating over a communication system as claimed in claim 73 wherein if a register queried by a first mobile transceiver about destination base station transceivers of a second mobile transceiver does not have this information the  
30 register forwards the request to another register.

75. A method of estimating a transition in a signal including the steps of:

sampling an incoming signal,  
comparing the sample levels in a first group of samples with the sample levels in  
a second group of samples,  
comparing the sample levels of samples within the first group of samples,  
5 comparing the sample levels of samples within the second group of samples,  
comparing the sample level of a middle sample with an adjacent middle sample  
where the middle samples are between the first group of samples and the second group  
of samples, and  
estimating a transition point in the signal from the comparisons.

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76. A method of estimating a transition in a signal as claimed in claim 75 wherein  
the middle samples do not form part of either the first group of samples or the  
second group of samples.

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77. A method of estimating a transition in a signal as claimed in claim 75 or 76  
wherein samples are taken continuously.

78. A method of estimating a transition in a signal as claimed in any one of claims  
75 to 77 wherein a continuous sliding window of six samples is analysed.

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79. A method of estimating a transition in a signal as claimed in any one of claims  
75 to 78 wherein the first group of samples contains two samples.

80. A method of estimating a transition in a signal as claimed in any one of claims  
25 75 to 79 wherein the second group of samples contains two samples.

81. A method of estimating a transition in a signal as claimed in claim 78 wherein  
the first group of samples contains the first two samples.

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82. A method of estimating a transition in a signal as claimed in claim 78 wherein  
the second group of samples contains the last two samples.

83. A method of estimating a transition in a signal as claimed in any one of claims 75 to 82 wherein a transition point is estimated to be between the middle samples if the middle samples are different, the samples in the first group are the same, the samples in the second group are the same and the samples in the first group are different to the samples in the second group.

84. A circuit for detecting a transition in a signal, the circuit adapted to:  
sample an incoming signal at at least twice the bit rate of the incoming signal,  
compare the sample levels in a first group of samples with sample levels in a second group of samples,  
compare sample levels of samples in the first group,  
compare sample levels of samples in the second group,  
compare the sample level of a middle sample with an adjacent middle sample where the middle samples are between the first and second groups, and  
from the comparisons output an estimate of a transition point in the signal.

85. A communication system that carries out synchronisation between communicating transceivers by:  
sampling an incoming signal at at least twice the bit rate of the incoming signal,  
comparing the sample levels in a first group of samples with sample levels in a second group of samples,  
comparing sample levels of samples in the first group,  
comparing sample levels of samples in the second group,  
comparing the sample level of a middle sample with an adjacent middle sample where the middle samples are between the first and second groups, and  
from the comparisons output an estimate of a transition point in the signal.

86. A method for synchronising the clocks of a first node and a second node in a network including the steps of:  
at a first time according to the clock of the first node sending a first synchronisation message from the first node to the second node,

at a second time according to the clock of the second node sending a second synchronisation message from the second node to the first node,

determining a first difference as the difference between the time on the first clock when the first message was sent and the time on the second clock when the first message was received,

determining a second difference as the difference between the time on the second clock then the second message was sent and the time on the first clock when the second message was received,

determining a clock error as the average of the difference between the first and second differences, and

adjusting the clock of either the first node or the second node by the clock error.

87. A method for synchronising the clocks of a first node and a second node in a network as claimed in claim 86 wherein the first time according to the clock of the first node is the same as the second time according to the clock of the second node.

88. A method for synchronising the clocks of a first node and a second node in a network as claimed in claim 86 wherein the first time according to the clock of the first node is different to the second time according to the clock of the second node.

89. A method for synchronising the clocks of a first node and a second node in a network as claimed in claim 86 wherein the clocks of both nodes are adjusted to reduce the clock error.

90. A method for synchronising the clocks of a first node and a second node in a network as claimed in any one of claims 86 to 89 further including the step of when the first node receives the second message the first node sends a third message to the second node including the time of receipt of the second message at the first node.

91. A method for synchronising the clocks of a first node and a second node in a network as claimed in claim 90 wherein the second node calculates the clock error.

92. A method for synchronising the clocks of a first node and a second node in a network as claimed in any one of claims 86 to 91 further including the step of sending a request from one node to the other node containing the time of the one node and adjusting the time of the other node to that of the one node prior to the first node sending a first message.

93. A method for synchronising the clocks of a first node and a second node in a network as claimed in any one of claims 86 to 92 wherein the first node is a master node and the second node is a slave node.

94. A network including a first node with a first clock and a second node with a second clock wherein to synchronise the first and second clocks:

the first node is adapted to send a first synchronisation message to the second node at a first time according to the clock of the first node,

the second node is adapted to send a second synchronisation message to the first node at a second time according to the clock of the second node,

one node is adapted to determine a first difference as the difference between the time on the first clock when the first message was sent and the time on the second clock when the first message was received,

one node is adapted to determine a second difference as the difference between the time on the second clock then the second message was sent and the time on the first clock when the second message was received,

one node is adapted to determine a clock error as the average of the difference between the first and second differences, and

adjusting the clock of either the first node or the second node by the clock error.

95. A network including a first node with a first clock and a second node with a second clock as claimed in claim 94 wherein the first time according to the clock of the first node is the same as the second time according to the clock of the second node.

96. A network including a first node with a first clock and a second node with a second clock as claimed in claim 94 wherein the first time according to the clock of the first node is different to the second time according to the clock of the second node.

5 97. A network including a first node with a first clock and a second node with a second clock as claimed in any one of claims 94 to 96 wherein the first node is further adapted to send a third message to the second node including the time of receipt of the second message at the first node when the first node receives the second message the first node.

10 98. A network including a first node with a first clock and a second node with a second clock as claimed in claim 97 wherein the second node is adapted to calculate the clock error.

15 99. A network including a first node with a first clock and a second node with a second clock as claimed in any one of claims 94 to 98 wherein one node is adapted to send a request to the other node containing the time of the one node and the other node is adapted to adjust the time of the clock of the other node to that of the one node prior to the first node sending a first message.

20 100. A network including a first node with a first clock and a second node with a second clock as claimed in any one of claims 94 to 99 wherein the first node is a master node and the second node is a slave node.

25 101. A communication system utilising a local area network, the network including a first node with a first clock and a second node with a second clock wherein to synchronise the first and second clocks:

the first node is adapted to send a first synchronisation message to the second node at a first time according to the clock of the first node,

30 the second node is adapted to send a second synchronisation message to the first node at a second time according to the clock of the second node,



one node is adapted to determine a first difference as the difference between the time on the first clock when the first message was sent and the time on the second clock when the first message was received,

one node is adapted to determine a second difference as the difference between  
5 the time on the second clock then the second message was sent and the time on the first clock when the second message was received,

one node is adapted to determine a clock error as the average of the difference between the first and second differences, and

adjusting the clock of either the first node or the second node by the clock error.

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102. A communication system utilising a local area network, the network including a first node with a first clock and a second node with a second clock as claimed in claim 101 wherein the first time according to the clock of the first node is the same as the second time according to the clock of the second node.

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103. A communication system utilising a local area network, the network including a first node with a first clock and a second node with a second clock as claimed in claim 101 wherein the first time according to the clock of the first node is different to the second time according to the clock of the second node.

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104. A communication system utilising a local area network, the network including a first node with a first clock and a second node with a second clock as claimed in any one of claims 101 to 103 wherein the first node is further adapted to send a third message to the second node including the time of receipt of the second message at the  
25 first node when the first node receives the second message the first node.

105. A communication system utilising a local area network, the network including a first node with a first clock and a second node with a second clock as claimed in claim 104 wherein the second node is adapted to calculate the clock error.

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106. A communication system utilising a local area network, the network including a first node with a first clock and a second node with a second clock as claimed in any

one of claims 101 to 103 wherein one node is adapted to send a request to the other node containing the time of the one node and the other node is adapted to adjust the time of the clock of the other node to that of the one node prior to the first node sending a first message.

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107. A communication system utilising a local area network, the network including a first node with a first clock and a second node with a second clock as claimed in any one of claims 101 to 106 wherein the first node is a master node and the second node is a slave node.

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108. A method of allocating communication resources for a mobile terminal in a communication system that utilises a base station network including the steps of:

identifying uplink channel usage in the range of the mobile terminal,  
identifying one or more spare uplink channels, and

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transmitting over the one or identified channels without negotiation with the base station.

109. A method of allocating communication resources for a mobile terminal in a communication system that utilises a base station network as claimed in claim 108

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further including the step of identifying a spare uplink channel for transmission to minimise interference.

110. A method of allocating communication resources for a mobile terminal in a communication system that utilises a base station network including the steps of:

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identifying downlink channel usage in the range of the mobile terminal,  
identifying one or more spare downlink channels, and

instruction a transmitting mobile terminal to utilise the identified channel(s) for transmission.

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111. A method of allocating communication resources for a mobile terminal in a communication system that utilises a base station network as claimed in claim 110

further including the step of identifying a spare downlink channel for transmission to minimise interference.

112. A method of transmitting a data stream from a first mobile terminal to a second mobile terminal over a communication system including the steps of:

identifying one or more spare channels for the downlink to the second terminal,  
separating the data stream into multiple portions according to the number of identified spare channels, and  
transmitting the multiple portions over the spare channels to the second terminal.

113. A communication system as wherein at each new time slot in a TDMA transmission the transmit or carrier frequency may change.

114. A communication system in which data is transmitted in packets wherein before transmitting data a transmitter provides a distinction between payload sequences and synchronisation sequences in the signal by scanning the payload sequence to determine any portions of the sequence that could be detected as a synchronisation sequence, introducing errors into the portions of the payload sequence, and wherein the introduced errors are within an error correction capability of a payload error correction code.

115. A communication system as claimed in claim 114 wherein errors are introduced into the payload data by toggling binary data bits.

116. A communication system including at least one register that can communicate over the communication system and adapted to store at least a portion of the network configuration information of the communication system.

117. A communication system as claimed in claim 116 wherein each register stores all the network configuration information of the communication system.

118. A communication system as claimed in claim 116 wherein each piece of network configuration information is stored in more than one register.

119. A communication system as claimed in any one of claims 116 to 118 wherein some devices using the communication system store the locations of at least one register.